Climate Change, Extreme Events and Impaired Health: Local to National Perspectives

National Center for Health Statistics

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SCHOOL OF PUBLIC HEALTH

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Outline

- **BACKGROUND**
  - Attributes of Changing Climate
    - Extreme events
- **EXTREME EVENTS and IMPAIRED HEALTH**
  - Local Perspectives
    - Extreme events and Adverse Health in MD

      Respiratory disease: Asthma; ***Cardiovascular disease***: Myocardial Infarction; ***Foodborne disease***: Salmonellosis
  - National Perspectives
    - Extreme events and Adverse Health in Contiguous US
      - ***Allergic disease:*** Hay Fever
- **QUESTIONS/DISCUSSION**

Definition

Weather:

- State of atmosphere at a given place and time
  - *Temperature, precipitation, wind speed/direction etc.*

Climate:

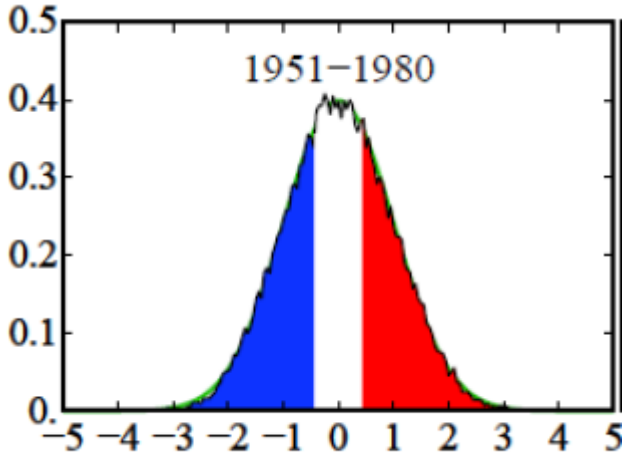
- Aggregated pattern of weather averages, extremes, timing, spatial distribution) of…
  - *hot & cold; cloudy & clear; humid & dry; drizzles & downpours; snowfall, snowpack, & snowmelt; blizzards, tornadoes, & typhoons*

Climate Variability:

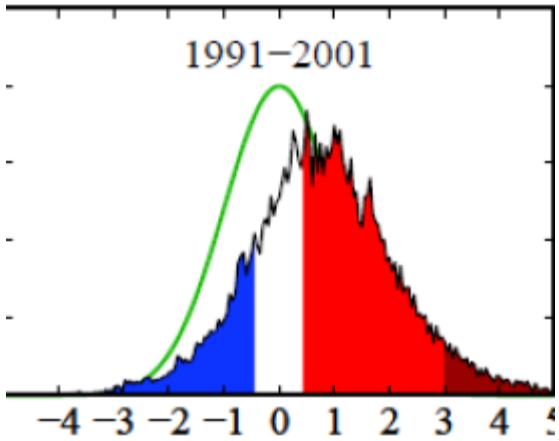
- Natural variability related to large scale whether phenomenon such as ENSO, PDO

Climate Change:

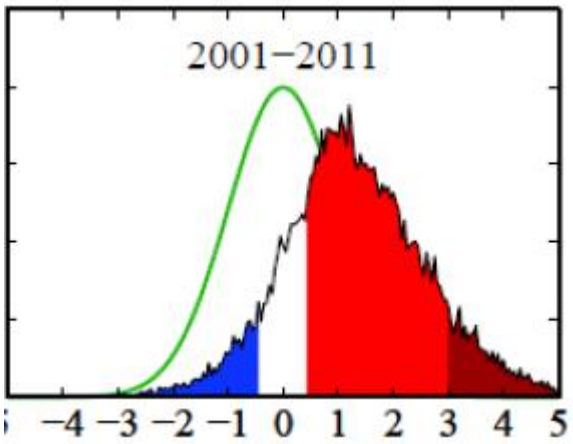
- Altered patterns of Climate
- Deviation from the long term averages
  - *Global average temperature is just one measure of the state of the global climate, but perhaps the only measure that is talked about.*



Occurrence of summertime temperature anomalies over land, relative to 1951-1980, in the unit of Standard Deviation



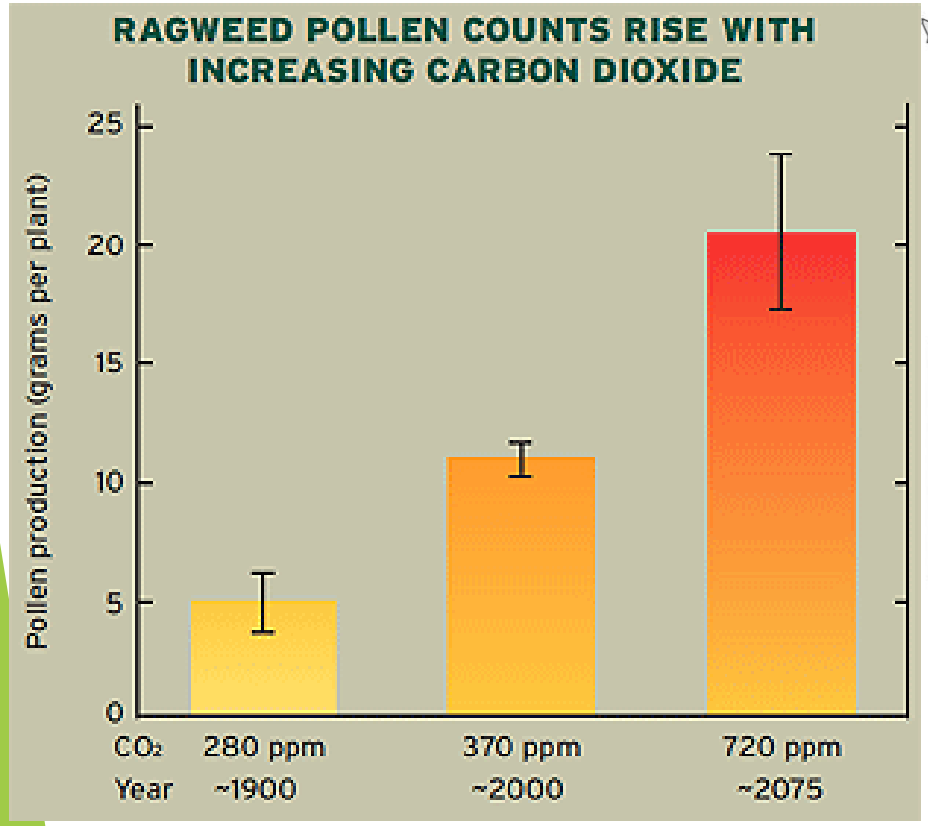
1991-2001



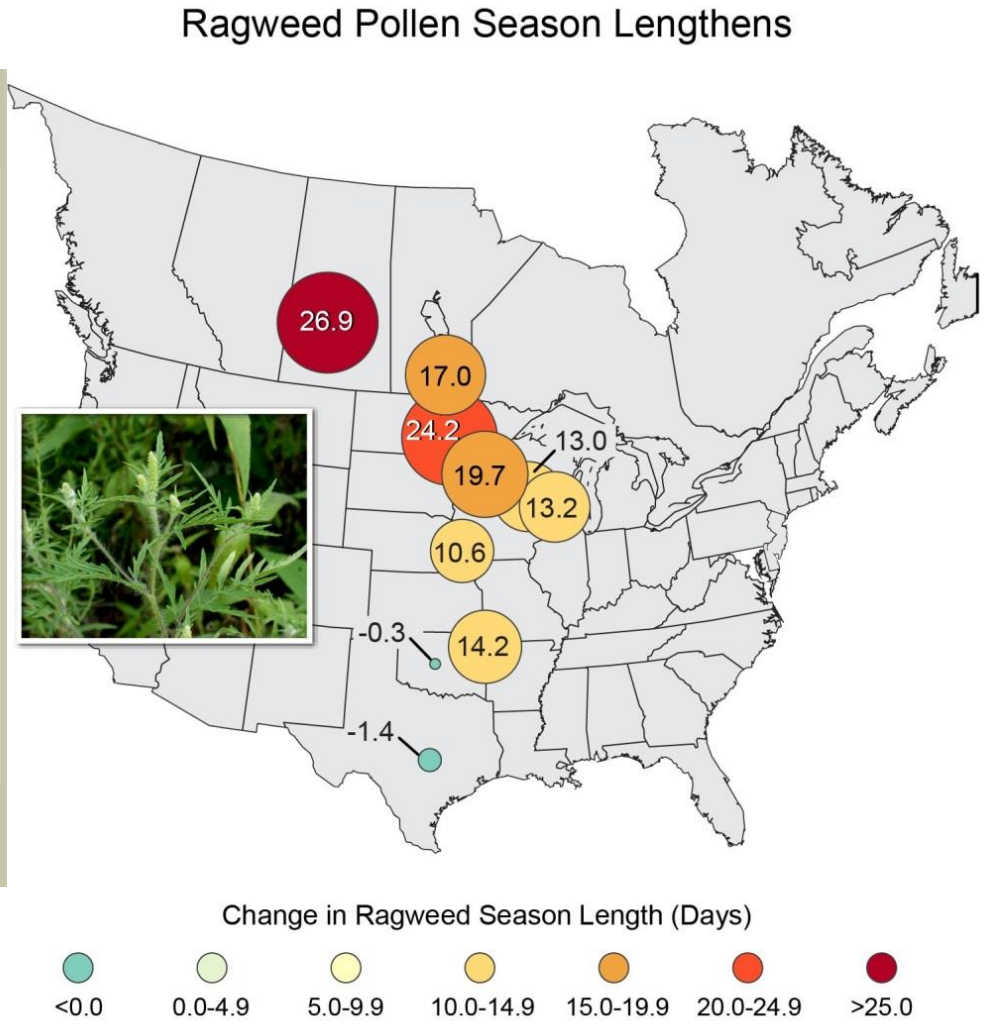
2001-2011

Hansen, Sato, & Ruedy 2012

Ecological Response to Changing Climate: Implication for Allergic Diseases



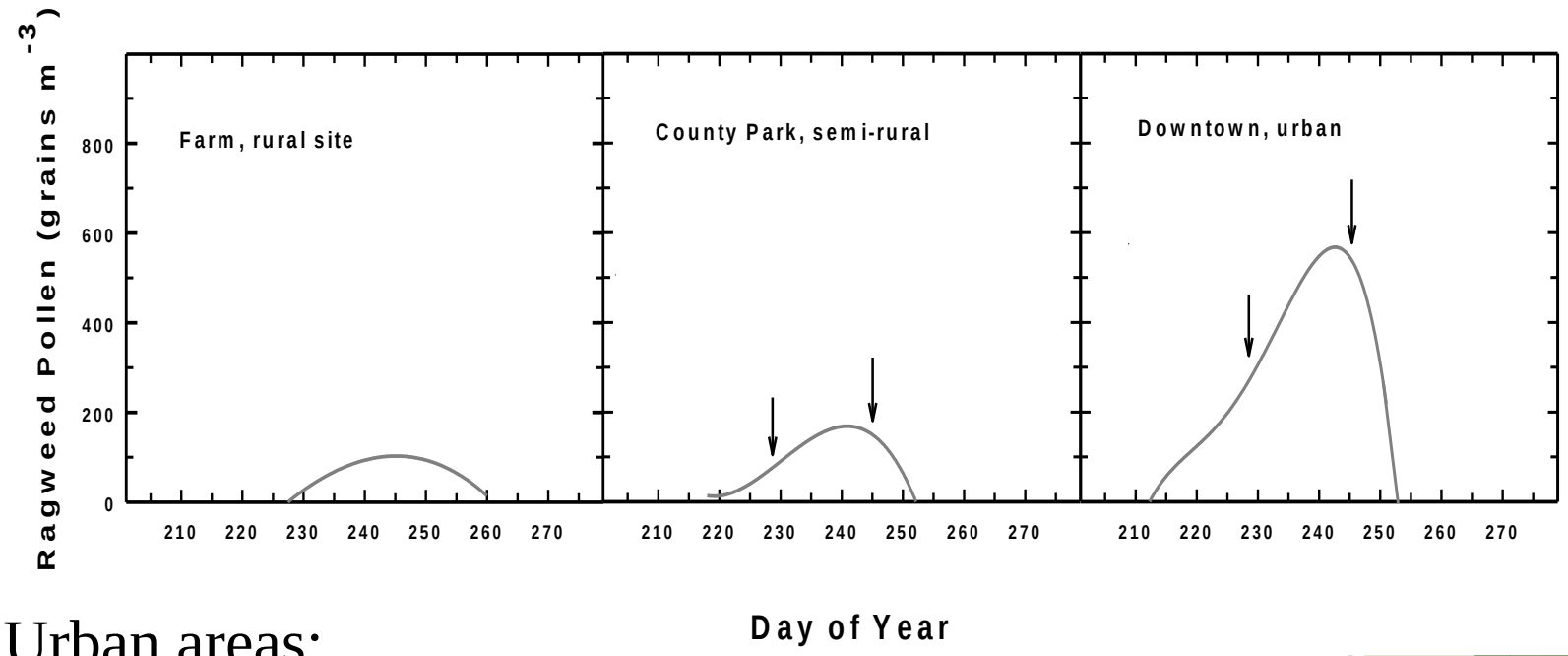
Ziska and Caulfield, 2000



Credit: Dr. Ziska, USDA
(Ziska et al. 2011)

Ecological Response to Changing Climate: Implication for Allergic Diseases

Ragweed pollen: Results from a natural experiment



Urban areas:

- Longer growing season, and higher pollen concentration
- Warmer temperatures, and more carbon dioxide.

Credit: Dr. Ziska, USDA

Climate Change and Extreme Events

- In response to our changing climate, extreme events will become:
  - More frequent, More intense, Longer lasting (Field et al. 2012)

- Question: How does frequency of extreme events impact **Human Health**?
  - Leverage EXISTING large datasets, taking advantage of both spatial and temporal contrast

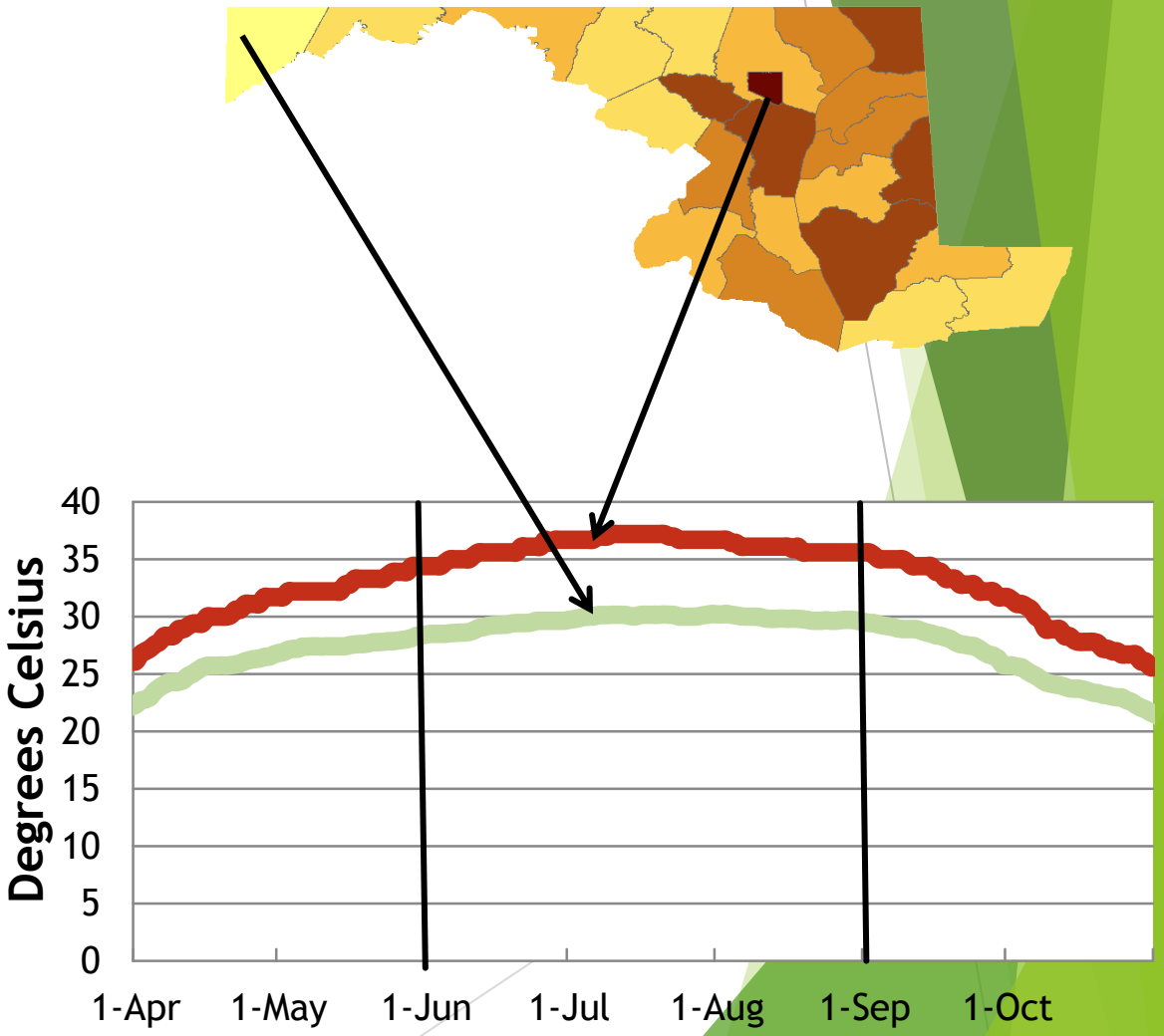
Local Perspectives: Maryland Experience

- Allergic Disease: Hospitalization for Asthma (2001-2013)
- Cardiovascular Disease: Hospitalization for heart attack (2001-2013)
- Foodborne Illness: *Salmonella* Infection in MD (2004-2013)

Methods: Extreme Heat Events in MD

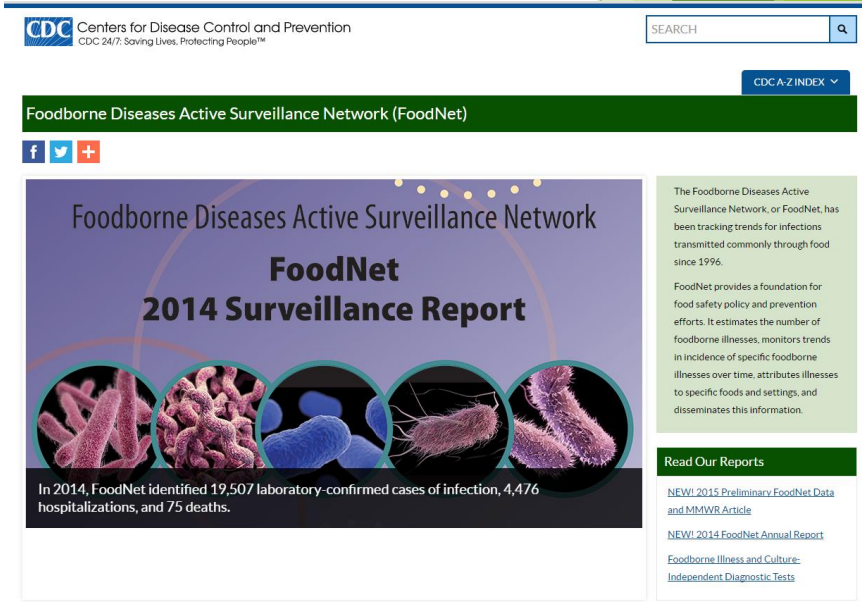
- County and calendar day specific "climate" information derived using 30 year of daily weather observations (1960-1989).
- 95th percentile of this distribution used as a threshold to identify extreme heat events for the study period (2001-2013)
- Threshold used to define extreme heat varies by county and by day

Example: ETT95 values on July 15th
(Range: 30-36 C)



Methods

- Sources of Data
  - Hospitalization for Asthma and AMI: Maryland Department of Health and Mental Hygiene.
  - *Salmonella* Infection: Maryland Foodborne Disease Active Surveillance Network (FoodNet)
- Statistical Analysis
  - Hospitalization for asthma and AMI: Time-stratified case-crossover, with 3 control periods (7,14, 21 days before/after).
  - *Salmonella* infection: Negative binomial generalized estimating equations.



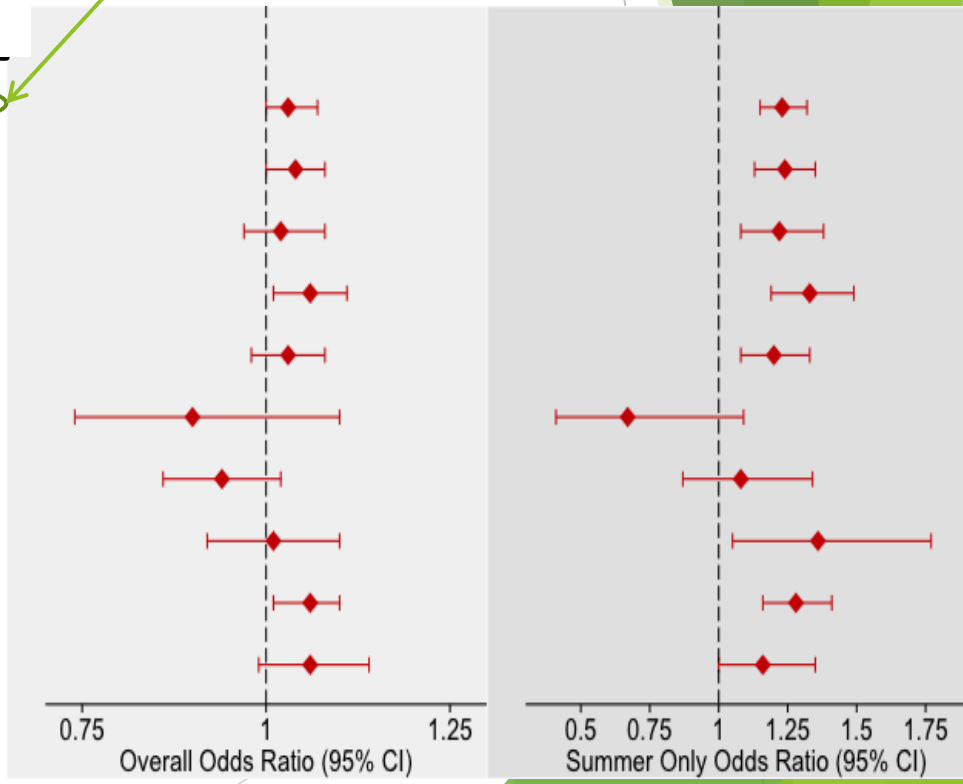
Demographic Characteristics of Health Data (2001-2013)

CHARACTERISTICS	Asthma Hospitalization		Heart Attack Hospitalization		Salmonellosis	
	# of Cases	% of Cases	# of Cases	% of Cases	# of Cases	% of Cases
Total	115,923	100	138,665	100	9,529	100
Age Group						
Under 5	18,043	16	58,036	42	2,380	25
5 to 17	16,649	14	80,629	58	1,661	17
18 to 64	59,462	51			4,462	47
65 and older	21,768	19			979	10
Gender						
Female	70,695	61	59,849	43	5,023	53
Male	45,226	39	78,812	57	4,475	47
Race/Ethnicity						
Non-Hispanic White	47,151	41	95,555	69	3755	39
Non-Hispanic Black	58,347	50	28,293	20	2,509	26
Hispanic	3,047	3	1,632	1	515	5
Other	3,479	3	5,987	4	293	3
Unreported	3,899	3	7,198	5	2,457	26
Season						
Winter	30,436	26	36,511	26	1,377	15
Spring	31,103	27	35,460	25	1,853	19
Summer	20,776	18	32,670	24	3,777	40
Fall	33,608	29	34,024	25	2,520	26

Extreme Heat Events and Risk of Hospitalization for Asthma

Related to 1 day increase in extreme heat event

Characteristics	Subgroups	Overall OR (95%CI	Summer Only OR (95%CI)
All	All of Maryland	1.03 (1.00, 1.07)	1.23 (1.15, 1.32)
Gender	Female	1.04 (1.00, 1.08)	1.24 (1.13, 1.35)
	Male	1.02 (0.97, 1.08)	1.22 (1.08, 1.38)
Race/Ethnicity	White	1.06 (1.01, 1.11)	1.33 (1.19, 1.49)
	Black	1.03 (0.98, 1.08)	1.20 (1.08, 1.33)
	Hispanic	0.90 (0.74, 1.10)	0.67 (0.41, 1.09)
Age Group	0 to 4	0.94 (0.86, 1.02)	1.08 (0.87, 1.34)
	5 to 17	1.01 (0.92, 1.10)	1.36 (1.05, 1.77)
	18 to 64	1.06 (1.01, 1.10)	1.28 (1.16, 1.41)
	65 and over	1.06 (0.99, 1.14)	1.16 (1.00, 1.35)



Soneja et al. Environmental Health, 2016

Differences in Risk of Hospitalization for Asthma Related to Extreme Heat Event

County/State	Season	OR (95% Confidence Interval)
Maryland	Summer	1.22 (1.15 – 1.33)
Baltimore City	Summer	1.36 (1.14 – 1.64)
Prince George's County	Summer	1.20 (1.01 – 1.41)
Washington County	Summer	1.76 (1.09 – 2.84)
Wicomico County	Summer	1.22 (0.77 – 1.94)

Exposure to Extreme Heat Event and Risk of Hospitalization for Heart Attack (2000-2012)

Characteristic	Cases	Extreme Heat Event OR and 95% CI
Overall Model	32,670	1.11 (1.05 – 1.17)
Gender		
Male	18,722	1.12 (1.05 – 1.21)
Female	13,948	1.09 (1.00 – 1.19)
Age		
Age 18-64	14,067	1.10 (1.02 – 1.20)
Age >=65	18,603	1.11 (1.04 – 1.20)
Race		
Non-Hispanic White	22,343	1.09 (1.02 – 1.16)
Non-Hispanic Black	6,730	1.27 (1.12 – 1.44)

Fisher et al, 2016 (Submitted)

Differences in Risk of Hospitalization for Heart Attack Related to Extreme Heat Across Counties

County/State	Summer Only Odds Ratio 95% CI)
Maryland	**1.11 (1.05, 1.17)**
Baltimore City	**1.43 (1.16, 1.75)**
Prince George's County	1.06 (0.91, 1.24)
Wicomico County	1.00 (0.74, 1.35)
Washington County	0.96 (0.71, 1.29)

Extreme Events and Salmonellosis

Characteristics	Extreme Heat Event	Extreme Precip. Event
Overall Model	1.041[1.013-1.069]	1.056[1.035-1.078]
Season		
Spring	0.961[0.926-0.997]	1.013[0.984-1.042]
Summer	1.045[1.014-1.077]	1.017[0.989-1.046]
Fall	1.004[0.964-1.045]	1.037[1.015-1.060]
Winter	0.962[0.928-0.998]	1.012[0.972-1.053]
Geographical Location		
Coastal Counties	1.051[1.023-1.081]	1.071[1.044-1.099]
Non-Coastal Counties	1.015[0.977-1.055]	1.036[1.017-1.054]

Considerably larger effect observed in coastal counties compared to non-coastal counties

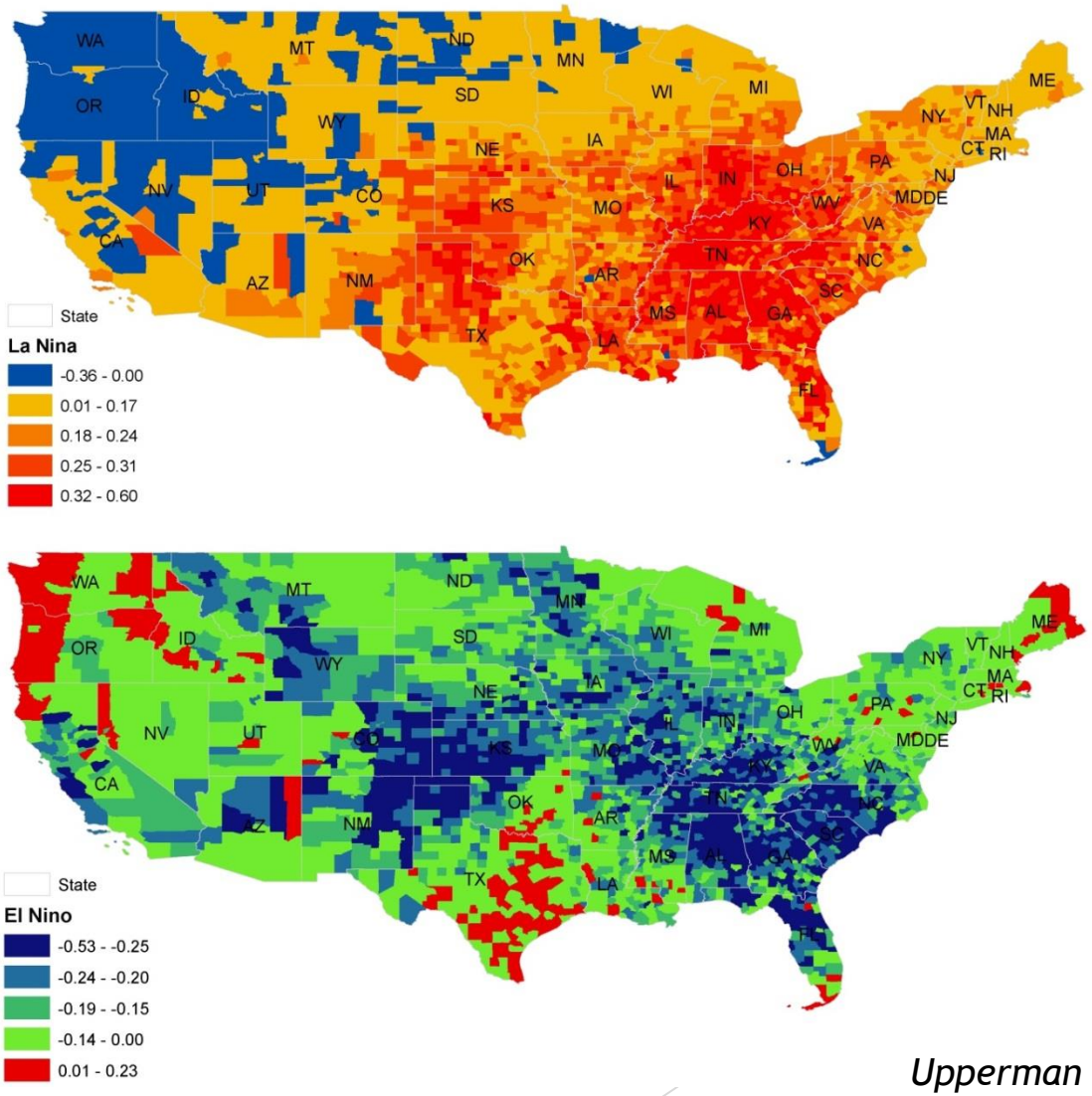
Jiang et al. Environment International 2015

Extreme Heat Events and Impaired Health: National Perspective

Outcome Measure: Hay Fever.

- Work performed at NCHS by doctoral student Crystal Romeo-Upperman
- NCHS Committee Members: Drs. Parker and Akinbami

Relative Change in Extreme Heat Event During La Nina and El Nino 1960-2010



Upperman et al, PLOS One 2015

Extreme Heat Events and Impaired Health: National Perspective

- Data Source: National Health Interview Survey, 1997-2013
- Hay fever question
  - “During the past 12 months, have you been told by a doctor or other health professional that you had hay fever?”
- 516,140 sample adults ≥18
  - 10,754 (2%) excluded

Demographic Characteristics

Charecterstics	Study Participants		Extreme Heat Event Quartiles			
	Overall	Hay Fever	0-10	11-16	17-24	>=25 days
Total N	505,386	42,601	111,524	113,255	123,998	156,609
Total Percent	100.0	8.4	21.9	22.5	24.7	30.9
Hay Fever						
No	91.6	-----	22.0	22.5	24.7	30.9
Yes	8.4	-----	21.1	22.7	24.6	31.6
Race/ethnicity						
non-Hispanic white	71.3	9.2	22.5	23.1	24.3	30.1
non-Hispanic black	11.5	6.8	22.6	21.0	24.8	31.7
Hispanic	12.5	5.7	19.0	20.7	25.8	34.6
All other races and et	4.7	8.1	19.8	22.3	26.2	31.7
Age						
18-34 years	31.3	6.2	21.7	22.6	25.0	30.7
35-49 years	29.4	10.3	21.9	22.5	24.8	30.9
50-64 years	22.9	10.1	21.7	22.6	24.3	31.4
65 years and older	16.5	7.0	22.8	22.2	24.2	30.9
Education						
<High school/GED	16.2	6.0	21.9	22.1	25.2	30.8
High school/GED	28.7	6.9	22.7	22.5	24.5	30.4
Some college	29.5	9.2	22.1	22.6	24.6	30.8
Bachelor's degree	16.8	10.3	21.1	22.6	24.6	31.7
Graduate degree	8.8	11.9	20.4	22.7	24.8	32.2
*Poverty Status^*						
Less than 100%	12.3	6.9	22.0	21.9	24.9	31.2
100 to less than 200%	18.4	7.0	22.8	21.9	24.7	30.6
200 to less than 400%	31.2	8.0	22.6	22.5	24.5	30.5
400% or greater	38.1	10.0	20.9	23.0	24.7	31.4

Results

Frequency of Extreme Heat Events	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
Q1 (0-10 days)[#]	1.00	1.00	1.00
Q2 (11-16 days)	1.06 (1.02-1.10)	1.05 (1.01-1.09)	1.05 (1.00-1.09)
Q3 (17-24 days)	1.04 (1.00-1.08)	1.05 (1.00-1.09)	1.04 (1.00-1.09)
Q4 (≥25 days)	1.07 (1.03-1.11)	1.07 (1.03-1.11)	1.07 (1.02-1.11)

[a]Unadjusted
[b]Adjusted for gender, race/ethnicity, age, education and poverty threshold
[c]additionally adjusted for urban-rural classification

Upperman et al, JACI-Practice, 2015 (In Revision)

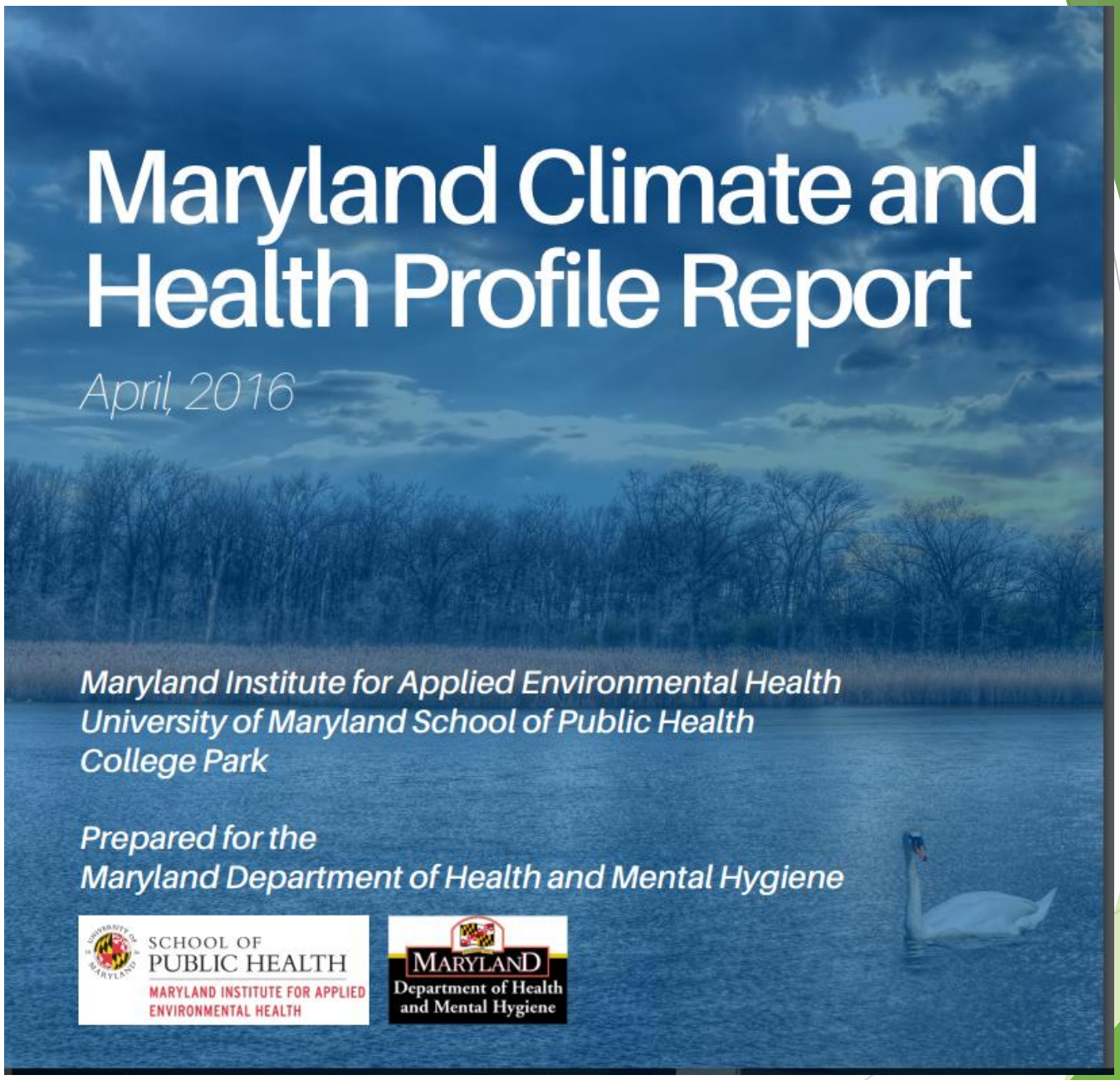
Results

Season	*Exposure Quartiles*	*AOR (95% CI)*
Spring	Q1 (0-2 days)[#]	1.00
	Q2 (3-4 days)	1.02 (0.98-1.06)
	Q3 (5-8 days)	1.04 (1.00-1.07)
	Q4 (≥ 9 days)	1.07 (1.03-1.12)
Summer	Q1 (0-2 days)[#]	1.00
	Q2 (3-4 days)	1.01 (0.97-1.05)
	Q3 (5-8 days)	1.02 (0.99-1.06)
	Q4 (≥9 days)	1.04 (1.00-1.07)
Fall	Q1 (0-2 days)[#]	1.00
	Q2 (3-4 days)	1.01 (0.97-1.04)
	Q3 (5-8 days)	1.00 (0.97-1.04)
	Q4 (≥9 days)	1.02 (0.98-1.07)
Winter	Q1 (0-2 days)[#]	1.00
	Q2 (3-4 days)	0.95 (0.92-0.99)
	Q3 (5-8 days)	0.98 (0.94-1.01)
	Q4 (≥9 days)	1.05 (1.01-1.09)

Upperman et al, JACI-Practice, 2015 (In Revision)

Summary

- In Maryland, exposure to extreme heat increases risk of hospitalization for Heart Attack and Asthma.
- Both extreme heat and extreme precipitation increase risk of *Salmonella* infection.
- The risk of *Salmonella* infection is higher in coastal communities.


Maryland Climate and Health Profile Report
April, 2016
Maryland Institute for Applied Environmental Health
University of Maryland School of Public Health
College Park
Prepared for the
Maryland Department of Health and Mental Hygiene
SCHOOL OF PUBLIC HEALTH
MARYLAND INSTITUTE FOR APPLIED ENVIRONMENTAL HEALTH
MARYLAND
Department of Health and Mental Hygiene

Summary

1. We observed a modest but significant association between exposures to extreme heat events and hay fever prevalence.
2. The findings were more pronounced for spring and winter extreme heat events.
3. First study to prove quantitative measure of allergy burden associated with extreme events on a national scale.

Concluding Thoughts

The New York Times | U.S.

Resettling the First American 'Climate Refugees'

By CORAL DAVENPORT and CAMPBELL ROBERTSON

Isle de Jean Charles, Louisiana